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BACTERIOLOGICAL FINDINGS IN FIFTEEN CASES OF EPIDEMIC CEREBROSPINAL MENINGITIS, WITH SPECIAL REFERENCE TO THE ISOLATION OF THE MENINGOCOCCUS FROM THE CONJUNCTIVA AND FROM THE CIRCULATING BLOOD.

BY G. CANBY ROBINSON, M.D.,
RESIDENT PATHOLOGIST, PENNSYLVANIA HOSPITAL, PHILADELPHIA.

(From the Ayer Clinical Laboratory, Pennsylvania Hospital.)

DURING the recent epidemic of cerebrospinal meningitis in Philadelphia there were in the wards of the Pennsylvania Hospital 15 cases of that disease from which the diplococcus intracellularis meningitidis was isolated. Three of the cases occurred in 1904, while the remaining 12 were seen during the late winter and spring of 1905. All of these cases were quite typical clinically, and this phase of the disease will not be here generally considered. The bacteriological findings of these 15 cases are tabulated in the accompanying table.

The organism isolated from these 15 cases of epidemic cerebrospinal meningitis was practically the same in all cases. As seen in the exudates obtained by lumbar puncture and at autopsy from the central nervous system it was always in pure culture and appeared as a medium-sized or fairly large biscuit-shaped diplococcus somewhat irregular in size. It sometimes occurred in tetrads and small groups. Definite chain formation was never noted. The organism was usually found both within and outside of the polymorphonuclear leukocytes. Of the eleven times in which the position in regard to the leukocytes was noted, the organism was seen entirely intracellular but twice. The number of organisms present in the exudates varied somewhat, although in only three of sixteen cases were many seen. Eleven times their number was noted as few, and in two cases none were seen at first examination, although cultures were positive. In one of these cases the organism was found after incubation of the exudate at 37° C. for twenty-four hours. It was observed in several cases that by this procedure the number of organisms present in the exudate could be increased. The proportion of intracellular to extracellular organisms was apparently increased by incubation, suggesting that phagocytosis by the leukocytes continued *in vitro.*

The organism always entirely or partially decolorized by Gram's method in the exudates. In twelve the decolorization was complete, while in five it was described as partial. In the latter cases the staining was usually quite irregular, some organisms losing their stain while others retained it. Similar results were found in the organisms from culture.

Capsular staining was not systematically carried out, but in a few instances the failure to find capsules was noted.

Coverslip preparations from cultures showed a medium-sized biscuit-shaped diplococcus, sometimes occurring in tetrads, never in definite chains, entirely or partially negative to Gram's stain.

On culture media the organism gave the following characteristics: Plain agar-agar. After twenty-four hours at 37° C. there is a rather delicate gray, sharply defined, raised pearly translucent thin-edged growth, which often has a slightly milky appearance in the thicker parts. The growth often takes place only along part of the streak of inoculation, and small gray, round, discrete colonies 2 to 5 mm. in diameter may develop along the streak. No difference is to be made out between the appearance of the twenty-four-hour and forty-eight-hour-old culture, as a rule, but after four to six days drying can be noticed. The edges of the growth then usually take on a rather characteristic wavy, laminated appearance. A moderately delicate growth takes place in a stab culture. The addition of glucose to the agar increases the luxuriance of the growth. No gas is produced in glucose agar stab cultures. The growth extends over the surface of the glucose agar slightly. On human blood agar the growth is more certain and more luxuriant than on plain agar. Here separate colonies are apt to form along the streak of inoculation. On Loeffler's blood serum there is seen a rather abundant gray, moist, raised growth. Bouillon is slightly clouded and a small sediment, which increases in size with several days' incubation, is seen. No pellicle formation is noted. Litmus milk is not altered, although coverslip preparations of the cultures show growth to have taken place. No growth takes place as a rule in gelatin at room temperature. A very delicate growth

No.	Date of admission.	Day of disease, lumbar puncture	Spinal fluid.	Coverslips from spinal fluid.	Cultures from spinal fluid, 24 hours at 37° C.	Remarks.	Lesions found at autopsy.	Bacteriological findings at autopsy.
1	June 6, 1904	7th	23 c.c., slightly turbid small sediment.	Small numbers rather large intracellular cocci, sometimes in pairs; negative by Gram.	Hydrocele agar; a few small colonies on 2 of 4 tubes used.	Recovery.		
2	May 27, 1904	19th	20 c.c., clear, white, transparent; medium-sized sediment.	Large intracellular cocci in pairs; none seen in Gram stain.	Hydrocele agar; several small gray colonies on all tubes.	Recovery.		
3	June 24, 1904	26th	2 c.c., clear fluid.	Centrifuged; no bacteria seen.	Blood serum; 20–30 small gray colonies; blood agar; 2 similar colonies.	Recovery; spinal fluid showed almost as many small mononuclear leukocytes as p. m. n. leukocytes.		
4	Feb. 6, 1905	5th	Amount and character not recorded; removed postmortem.	Many fairly large diplococci mostly intracellular; Gram negative; capsules negative.	Blood agar; extensive growth nearly covering surface by confluent colonies; blood serum; extensive yellowish slightly slimy growth.	Death; autopsy 17 hrs. after death.	Acute purulent cerebrospinal leptomeningitis; bronchopneumonia; otitis media of both ears; parenchymatous degeneration.	Meningococcus isolated from cerebral exudate and right middle ear; staphylococcus pyogenes aureus and albus from right lung; B. coli communis from heart's blood and right middle ear.
5	Feb. 20, 1905	(a) 2d	12 c.c., slightly turbid; coagulum found on standing.	A few leukocytes contain fairly large cocci in pairs; a number of cocci outside of leukocytes.	Blood agar; good-sized translucent growth, confluent and discrete.	Lumbar punctures done late in disease for therapeutic reasons. Recovery.		
		(b) 13th	No examination.					
		(c) 47th	30 c.c., clear, water-like fluid; delicate coagulum found on standing.	None made.	Blood agar; after 48 hrs. at 37° C. 4 colonies 4 mm. in diam. and a little growth above water of condensation seen.			
		(d) 57th	60 c.c., slightly turbid straw-colored, blood tinged.	No bacteria: poorly preserved p. m. n. leukocytes.	Cultures negative.			
		(e) 73d	Not noted.	None made.	Cultures negative.			

No.	Date of admission.	Day of disease, lumbar puncture	Spinal fluid.	Coverslips from spinal fluid.	Cultures from spinal fluid, 24 hours at 37° C.	Remarks.	Lesions found at autopsy.	Bacteriological findings at autopsy.
6	Feb. 17, 1905	6th	3 c.c. bloody; removed postmortem.	No bacteria seen after removal; after 24 hrs. at 37° C. small number of rather large cocci in tetrads and clusters; stain poorly in Gram stain.	Blood agar; large number of colonies pinpoint in size to 2 mm. in diameter.	Death; autopsy not permitted.		
7	Feb. 24, 1905	4th	7 c.c., white, turbid, milky fluid.	A few medium-sized, biscuit-shaped diplococci, usually extracellular; none seen in Gram stain.	Blood agar; numerous small discrete pearly gray colonies.	Recovery.		
8	Feb. 28, 1905	6th	12 c.c., slightly turbid, white fluid with small coagulum at bottom.	A few rather large cocci, some in pairs, some intracellular.	Blood agar; surface studded with discrete colonies.	Death; autopsy 32 hrs. after death.	Acute purulent leptomeningitis marked congestion of brain, bronchopneumonia, congestion of all organs, cloudy swelling of liver and kidneys, acute splenic tumor.	Meningococcus isolated from lateral ventricle of brain; streptococcus pyogenes, B. coli communis, and an undetermined coccus isolated from lungs; heart's blood culture remained sterile.
9	April 6, 1905	4th	10 c.c., turbid, milky fluid.	A few biscuit-shaped diplococci, some of which are intracellular; partially negative by Gram.	Blood agar; no growth; blood serum; large number of moist gray colonies ½–2 mm. in diameter.	Recovery.		
10	April 13, 1905	(a) 2d	8 c.c., milky white fluid, showing a fine coagulum.	A few biscuit-shaped diplococci, partially negative by Gram.	Blood serum; numerous small moist gray colonies confluent in places.	Recovery.		
		(b) 5th	37 c.c., yellowish turbid fluid.	A few biscuit-shaped diplococci, usually extracellular; negative by Gram.	No cultures made.			

No.	Date of admission.	Day of disease, lumbar puncture.	Spinal fluid.	Coverslips from spinal fluid.	Cultures from spinal fluid, 24 hours at 37° C.	Remarks.	Lesions found at autopsy.	Bacteriological findings at autopsy.
11	April 13, 1905	3d	5 c.c., turbid almost purulent white fluid.	A few large biscuit-shaped diplococci intra and extracellular; negative by Gram.	Blood serum; number of gray soft colonies in areas of depression.	Meningococcus isolated from circulating blood; coverslips and cultures on blood serum from purulent conjunctivitis negative for meningococci. Death: autopsy 19 hours after death.	Subacute cerebrospinal meningitis, congestion of lungs, cloudy swelling of liver and kidneys, acute splenic tumor, erysipelas.	Meningococcus isolated from heart's blood, base of brain, spinal cord.
12	May 9, 1905	(a) 2d	3. c.c., turbid milky fluid containing fibrin-like flakes.	A few medium-sized cocci, some biscuit-shaped diplococci. None seen in Gram stain.	Cultures on blood serum, blood agar and glucose agar remained sterile after 5 dys. at 37° C.	Cultures made from conjunctiva on 18th day on blood agar and glucose agar; negative for meningococci: blood cultures made on 3d, 8th, and 20th days; all negative except for coverslips from first culture. Death.	Acute cerebrospinal leptomeningitis, congestion of brain, lungs, liver, spleen, and kidneys; acute bronchopneumonia, cloudy swelling of liver and kidneys.	Streptococcus pyogenes and staphylococcus pyogenes aureus from right lung; blood agar tube cultures from base of brain and heart's blood remained sterile 6 days at 37° C.; culture from conjunctiva negative from meningococci.
		(b) 13th	40 c.c., turbid milky fluid.	A few biscuit-shaped diplococci, some intra- and some extracellular; partially negative by Gram; no tubercle bacilli found.	Abundant growth of about 50 semitranslucent colonies appeared on glucose agar after 3 days at 37° C. on tube on which a large mass of the purulent sediment was transferred.	The organism was grown with great difficulty; cultures made in the usual way by transferring several loopsful of fluid to glucose and blood agar remained sterile after 5 days at 37° C.; similar difficulty at autopsy.		
13	May 18, 1905	3d	50 c.c., yellowish-white, almost milky turbid fluid.	A good number rather large cocci, some of which are biscuit-shaped diplococci.	Blood agar; about 30 moist gray colonies 2–3 mm. in diameter; glucose and plain agar each show about 50 colonies 1–2 mm. in diameter.	Blood culture on 3d day of disease negative. Recovery.		

No.	Date of admission.	Day of disease, lumbar puncture.	Spinal fluid.	Coverslips from spinal fluid.	Cultures from spinal fluid, 24 hours at 37° C.	Remarks.	Lesions found at autopsy.	Bacteriological findings at autopsy.
14	May 30, 1905	2d	10 c.c., turbid milky fluid containing a fairly large sediment.	Fairly large biscuit-shaped diplococci intra- and extracellular; partially negative by Gram.	Blood agar; a number of somewhat irregular, soft, gray, translucent colonies.	Blood cultures taken on 2d and 6th days of disease negative. Death: autopsy one hour after death.	Acute cerebrospinal meningitis, acute bronchopneumonia, congestion and cloudy swelling of liver and kidneys, acute splenic tumor, acute ganglenitis of Gasserian ganglion.	Streptococcus pyogenes aureus isolated from right lung; cultures from heart's blood, base of brain and cerebral cortex remain sterile, although a few biscuit-shaped diplococci intra- and extracellular negative by Gram seen in some of the coverslips; cultures from conjunctiva failed to show meningococci.
15	Feb 25, 1905	None made	....	....	....	On 6th day of disease cultures were made from a purulent conjunctivitis and the meningococcus isolated. Death: autopsy ten hours after death.	Acute cerebrospinal leptomeningitis, acute bronchopneumonia with purulent bronchitis, acute splenic tumor, cloudy swelling of liver, congestion and cloudy swelling of kidneys.	Meningococcus isolated from lateral ventricles; streptococcus pyogenes from the lungs; cultures from heart's blood and cerebral cortex remained sterile; coverslips from left conjunctiva, cerebral pus, and pus at base of brain show biscuit-shaped diplococci intra- and extracellular.

without liquefaction of the medium was noted in seven of the twenty-seven strains grown.

It is apparent that our organism in all cases coincides quite definitely with the organism described by Weichselbaum and his followers, as the diplococcus intracellularis meningitidis. Chain formation, capsules, and Gram staining, claimed for it by Jaeger and others, were never noted.

The character of the cerebrospinal fluid from which the meningococcus was isolated was noted in fifteen instances, sometimes more than once in the same case. It was described as milky or thinly purulent in nine instances, slightly turbid in three, and clear three times. In all the cases showing a clear fluid the lumbar puncture was made late in the disease, on the nineteenth, twenty-sixth, and forty-seventh days, respectively. When the spinal canal was tapped several times the fluid was seen to become clearer as the case progressed.

Of the seventeen spinal fluids from which the meningococcus was grown, thirteen were withdrawn during the first seven days of the disease. In the latest case the organism was isolated from spinal fluid obtained on the forty-seventh day of disease. This case, No V. of the above table, was a girl aged three years, who entered the Pennsylvania Hospital, service of Dr. J. A. Scott, on the second day of her illness, February 20, 1905. She had a typical attack of epidemic cerebrospinal meningitis. Lumbar puncture on the second day of her disease showed slightly turbid fluid, from which the meningococcus was isolated. On the forty-seventh day 30 c.c. of a clear, water-like fluid was obtained by lumbar puncture from which the meningococcus was again isolated. Fluids obtained on the fifty-seventh and seventy-third days were clear except for blood tinging of the former, and both were negative for meningococci. This case presents evidence that late in the disease the meningococcus may be present without the accompaniment of a purulent exudate. The organism is not frequently found so late in the disease. In von Lingelsheim's 138 cases, positive for the meningococcus, from only six was the organism isolated after the twentieth day. He reports isolating the organism from lumbar puncture fluid on the forty-ninth and twice on the sixtieth day. Weyl isolated the meningococcus from fluid obtained by lumbar puncture on the forty-ninth day.

The amount of the fluid obtained by lumbar puncture from which the organism was isolated measured from 2 to 60 c.c. It averaged 19½ c.c. For the purpose of isolating the meningococcus from the exudate Loeffler's blood serum, as suggested by Councilman, Mallory, and Wright, was found to be the most certain. Blood agar, hydrocele agar, and glucose agar were also used. The growths on the cultures from the exudates were described as abundant in 11, scanty in 3, and absent in 1 of the 15 inoculations where this point was noted. The number of organisms seen in coverslips was not always an indication of the luxuriance of the growth obtained, and the organism from some cases grew apparently with much greater ease than from others. The organism isolated from Case XII. was persistently difficult to grow. The first lumbar puncture showed in coverslips a few medium-sized cocci and some biscuit-shaped diplococci, negative by Gram stain. Cultures on blood-serum, blood agar, and glucose agar remained sterile after five days at 37° C. The second lumbar puncture on the thirteenth day of the disease contained organisms similar to those in the first. Several loopfuls of the fluid were transferred to glucose agar and blood agar, but these tubes remained sterile five days at 37° C. Later a large mass of purulent sediment was smeared over a glucose agar tube. After three days at 37° C. an abundant growth of typical meningococci occurred. At the autopsy cultures from pus at the base of the brain remained sterile, although coverslips from it showed a few indefinite Gram-negative diplococci. One of the blood cultures in this case, to be spoken of later, showed a diplococcus in coverslips, but no growth could be obtained from it.

The bacteriological findings from the six autopsies obtained in the seven deaths that occurred in the series show the meningococci isolated from the central nervous system in four cases. In the two negative cases it was obtained only in coverslips, but from both the organism was obtained in pure culture from the patient during life. Four times the heart's blood remained sterile, once it showed the presence of B. coli communis, and in one case the meningococcus was obtained from it. In one case the meningococcus was obtained together with B. coli communis from the middle ear, and in another it was seen in coverslips from the pus of a purulent conjunctivitis.

In five of the six autopsies acute bronchopneumonia was found, and from all the ordinary pyogenic cocci were isolated; the meningococcus from none.

THE PRESENCE OF THE DIPLOCOCCUS INTRACELLULARIS MENINGITIDIS IN THE CIRCULATING BLOOD. The organism has been isolated from the blood during life in a comparatively small number of cases. Gwyn, in 1899, was the first to obtain positive results, when he grew the meningococcus from the blood of a typical case of meningitis complicated by arthritis. His positive culture was made on the fifth day of the disease, and the day before the patient died.

Salomon, in 1902, isolated the same organism twice from a patient suffering with meningitis complicated by arthritis. His successful cultures were made on the eighth day of the disease and again four weeks later.

Warfield and Walker grew the organism from the circulating blood of a patient suffering from endocarditis. Death took place ten days later, and they obtained the diplococcus again at autopsy from the vegetations on the heart valves.

Lenhartz, in his article in Nothnagel's *System of Medicine,* reports one case where the blood taken six hours before death showed the presence of the meningococcus and the streptococcus. In a later communication this author mentions another case in which he succeeded in isolating the meningococcus from the circulating blood.

Möller, in 1903, reported his findings concerning the meningococcus in the blood withdrawn the day before death. In this case the description of the organism is meagre, but the findings are accepted as correct by Weichselbaum.

More recently Martini and Rohde succeeded in isolating the meningococcus from the circulating blood on the second and fourth days of the disease in one case. Lumbar puncture was also positive for meningococci.[1]

In all these cases the organism corresponded practically exactly to that described by Weichselbaum and Albrecht and Ghon.

A number of investigators have reported negative results from their attempts to isolate the meningococcus from the blood. Thus White reports eight negative cases in which methods similar to those employed by successful workers were used. Bettencourt and Franca, working in the Lisbon epidemic, report six negative cases. Councilman and his co-workers, after making cultures from the heart's blood of 35 cases at autopsy unsuccessfully, conclude that the meningococcus does not enter the general circulation.

Blood cultures were made from the circulating blood in 4 of our cases. From 1 of these cases three cultures on the second, sixth, and eighteenth days of his disease were made, the last being on the day before death. In the first blood culture 18 c.c. of blood from the arm vein were distributed between one flask containing 250 c.c. of glucose bouillon and three flasks containing 100 c.c. of bouillon each. The glucose-bouillon flask became contaminated, but after six days incubation at 37° C. the other flasks showed clouding and darkening of the blood on the bottom. Coverslips from two of these flasks were negative, but from one there were found a few medium-sized biscuit-shaped diplococci in small clusters. None were seen in Gram-stained smears. Cultures made from the flask on blood agar and glucose agar remained always sterile. This blood culture was taken from the case mentioned above where the meningococcus was grown only once with much difficulty from the cerebrospinal fluid, and where another lumbar puncture and the exudate about the central nervous system at autopsy failed to show the organism except in coverslips.

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[1] Since the completion of this paper the work of Elser (Journal of Medical Research, 1905, vol. xiv. p. 89) has appeared. He made cultures from the blood of forty-one cases of epidemic cerebrospinal meningitis, using a mixture of ascitic fluid and plain bouillon as a medium, and isolated the meningococcus from ten of the cases.

In a second case two negative blood cultures were made on the second and sixth days of the illness, 8 c.c. of blood being used in each culture and put into three and four flasks, respectively, containing 250 c.c. of bouillon each. Death occurred on the eighth day of the disease.

In a third case a blood culture made on the third day of the disease failed to show the meningococcus. Ten c.c. of blood were withdrawn and distributed between three flasks containing 250 c.c. of bouillon each.

In the fourth case 18 c.c. of blood were withdrawn from the arm vein and put into two flasks containing 250 c.c. each and one containing 100 c.c. of bouillon. After incubation at 37° C. for forty-eight hours one flask containing 250 c.c. of bouillon and the 100 c.c. flask showed signs of growth, and coverslips from them showed a number of rather large, definite, biscuit-shaped diplococci, negative by Gram. Cultures were made on Loeffler's blood serum and blood agar from these two flasks, and from each was obtained a pure growth of the diplococcus intracellularis meningitidis. It was a biscuit-shaped diplococci sometimes in tetrads, partially negative by Gram, which grew on all media identically with the cultures described above and corresponded in all respects to the organism isolated from the spinal fluids of this and the other cases studied.

The case was that of J. D., aged twenty-three years, colored, house servant. He entered the service of Dr. Morris J. Lewis April 13, 1905, in an unconscious and delirious condition during the second day of the disease. His family and past history were negative. He had had no ear disease nor injury to head, nor had he suffered from a cough or a cold. His present illness began April 11th, two days before admission to the hospital, with severe headache, which came on after work and prevented him from sleeping. He vomited several times, but had no convulsions and lost consciousness about fifteen hours after onset. On admission he presented a fairly typical picture of epidemic cerebrospinal meningitis. His head was slightly retracted and the patient cried out whenever it was brought forward. Beginning herpes seen on lips. Kernig's sign present, knee-jerks absent. A few indefinite doubtful spots were seen on abdomen. On April 14th, third day of disease, the patient could answer questions but seemed a little confused. Leukocytes 40,000. A lumbar puncture was made and 5 c.c. of a thinly purulent fluid were obtained, which showed the presence of the meningococcus. On April 17th, on the day when the successful blood culture was obtained, a purulent conjunctivitis was noted. Cultures from the pus failed to show meningococci. The patient improved steadily from time of admission, and on April 27th seemed on the road to recovery. His knee-jerks had returned and the rigidity of his neck had largely disappeared. On this day, however, the sixteenth of his disease, erysipelas of the face was noted. It gradually spread over the back, neck, and face. The patient died on May 4th, the twenty-fourth day of disease. Before death no nucal rigidity could be noticed. His temperature during a large part of his illness was subnormal, but took on much irregularity after the erysipelas set in, ranging from 97 to 103°. Autopsy performed by Dr. Longcope nineteen hours after death.

Anatomical Diagnosis. Subacute cerebrospinal meningitis, congestion of lungs, cloudy swelling of liver and kidneys, acute splenic tumor, erysipelas.

The examination of the brain showed a slight flattening of the cerebral convolutions. The dura mater was delicate. The vessels over the cortex were much injected and in places the pia mater had a slightly milky appearance. This was most marked about the base, and over the cerebellum and corpora quadrigemina there was a definite accumulation of thick sticky yellow pus. The ventricles were not distended, but contained a little turbid fluid. Upon opening the dura mater of the spinal cord the vessels of the pia mater were found to be somewhat injected. The subarachnoid space was partially obliterated by delicate, soft, fibrous adhesions, especially in the lower dorsal region. There was no purulent material to be seen in the subarachnoid space, and the cord itself was well preserved.

Cultures were made at autopsy from heart's blood, base of brain, and from spinal cord, and from all definite cultures of the meningococcus were obtained. Agar plate and blood-agar tube cultures were made from the heart's blood. The former remained sterile after several days' incubation. After incubation for twenty-four hours at 37° C. it was noticed that the blood agar was contaminated, but quite distinct from the colonies of contamination there was a number of minute delicate discrete colonies, coverslips from which showed a rather large biscuit-shaped diplococcus partially negative by Gram. On subcultures this organism was identical to the meningococci isolated from the brain and cord of this and other cases.

This was the only case of the six which came to autopsy that showed the meningococcus in the heart's blood.

A review of the work done upon the subject of the presence of the diplococcus intracellularis meningitidis in the circulating blood shows a comparatively small number of the attempts at cultivation of the organisms from this source to be successful. This naturally leads to the conclusion that the organism is an occasional invader of the circulating blood; a similar position held by many concerning the typhoid bacillus and the pneumococcus when these organisms were first being isolated from the circulating blood. Perhaps improved technique and a larger collection of cases will show epidemic cerebrospinal meningitis to be a true bacteriæmia in practically all cases, as has been shown in regard to typhoid fever and pneumonia, but at present the former view that the organism is only an occasional invader of the blood seems all that is justified. That the meningococcus may be more than an agonal invader of the blood is shown by the cases of Salomon, who isolated the organism both early and late in the same case from the blood; of Warfield and Walker, when the patient lived ten days after their successful blood culture, and appeared to have suffered from a disease caused by the meningococcus. Martini and Rohde's, where the organism was isolated on the second and again on the fourth day of the disease, also bears on this point, and our case, where the patient became much better in the time between the successful blood culture and the autopsy, where the organism was again isolated from the blood, makes it evident that other than agonal invasions of the blood occur. In the case where the organisms were obtained in coverslips only from the bouillon flask it was from the first and not from the last blood culture that this was done. In the cases of Gwyn, one of Lenhartz and of Möller, however, the successful blood cultures were made shortly before death.

THE OCCURRENCE OF THE DIPLOCOCCUS INTRACELLULARIS MENINGITIDIS IN THE CONJUNCTIVA. That purulent conjunctivitis occurs as a not infrequent complication of epidemic cerebrospinal meningitis has been noted by a number of observers. Thus, Councilman and his co-workers observed it ten times in 111 cases. Davis considers it a very common symptom, and found conjunctivitis present eight times in 31 cases of meningitis examined. Bacteriological examinations of purulent conjunctivitis complicating meningitis has been but seldom reported. Fraenkel reports the isolation of the meningococcus from 3 cases of conjunctivitis, and Haglund from 1 case, but the descriptions of the organisms in all these cases varies in some important details from Weichselbaum's description. Weichselbaum and Albrecht and Ghon consider that the organisms isolated by the two-mentioned investigators are not identical with the meningococcus of Weichselbaum. Wintersteiner reports a case of ophthalmia arising in the course of a case of meningitis. In coverslips from the eye an organism identical morphologically with the meningococcus grown from the spinal fluid was found. Weichselbaum studied Wintersteiner's preparations, and although no cultures were obtained, he considers the finding positive. Wintersteiner thinks the infection occurred as a metastatic process. Councilman and his co-workers report one negative culture from a conjunctivitis.

In our series of cases cultures were taken from the conjunctiva in three cases during life and from another case at autopsy. Two of the cases showed a purulent conjunctivitis, and from one of these cases the meningococcus was grown. The other cases failed to show the organism.

The successful case was that of J. B., colored, porter, aged twenty-two years. Entered the hospital, service of Dr. Arthur V. Meigs, February 25, 1905, in the third day of his illness. Family and past history negative. The present illness began February 23d, two days before admission, with a sore throat in the morning, which did not keep him from work. He had a severe headache all day, however, and was restless and moaning during the night. At noon of the day before admission the patient became wildly delirious and remained unconscious up to time of admission to the hospital.

Physical Examination. The patient was a wildly delirious man, talking and shouting incessantly, and pitching about the bed. His arms and neck were rigid. Pupils were equal, dilated, and apparently sometimes irregular, but responded slightly to light. Left eye sometimes pointed independently outward. No facial paralysis was noticed. Heart and lungs were negative. Pulse soft and full, spleen not palpable. Abdomen negative. Kernig's sign was positive. No spots were seen on skin. On the day after admission, fourth day of disease, a large mass of herpes appeared on lips. Respiration quickened and there was noted a slight impairment of resonance and distant breath sounds with a few minute crackles at the right base posteriorly. On February 28th, sixth day of disease, a marked purulent conjunctivitis in both eyes was observed. On the following day the patient died. During his illness his temperature varied from $99\frac{2}{5}°$ to $101\frac{2}{5}°$ until the day of his death, when it rose rapidly to 106°.

Cultures were made on February 28th from the purulent conjunctivitis of the left eye on blood agar and blood serum. On the former, after eighteen hours at 37° C., there was a large growth which toward the bottom appeared as moist, raised colonies, somewhat irregular in shape, about 1 mm. in diameter, between which lay very minute colonies. At the upper part of the tube the growth was composed of many very minute colonies, closely packed. Coverslips from the tube showed biscuit-shaped cocci in pairs and tetrads and singly. Nearly all the organisms decolorized by Gram, but a few short stubby bacilli and perhaps some cocci in chains were seen stained by Gram. On the blood serum a large growth composed of moist, confluent colonies below and whitish-gray, discrete, small or minute colonies above, were seen. Coverslips were similar to those from blood agar.

In subcultures the diplococcus intracellularis meningitidis was obtained in pure culture and grown on the various culture media. It corresponded exactly to the organisms obtained from the spinal fluids of other cases and to the organism obtained from the lateral ventricles of the brain of this case at autopsy. This meningococcus never showed any of the characteristics which Lord ascribes to the micrococcus catarrhalis. The colonies did not increase in size after several days on agar, but became thin and dry in nine days. The growth on agar was always quite delicate and never showed mortar-like coarsely granular colonies with irregular margins. The growth was quite delicate throughout and did not occur at room temperature in gelatin.

At the autopsy of this case, which was performed ten hours after death by Dr. Longcope, there was found acute cerebrospinal leptomeningitis, acute bronchopneumonia with purulent bronchitis, acute splenic tumor, cloudy swelling of liver, congestion and cloudy swelling of kidneys, and inflammation of the Gasserian ganglion.

Over the surface of the brain there was a considerable quantity of yellowish-gray purulent exudate beneath the pia mater, which gave it a mottled appearance. This exudate lay principally along the bloodvessels and was especially marked over the cortex and basal nuclei, pons, and anterior surface of the cerebellum. The ventricles were slightly dilated and contained thick reddish-gray pus, from which the meningococcus was isolated. Meningococcus-like organisms were found in coverslips from the left conjunctiva, and from the pus at base of brain.

RESUME. In a study of 15 cases of epidemic cerebrospinal meningitis the organism isolated from the spinal fluid, circulating blood, pus from the conjunctiva, and from the central nervous system at autopsy, agrees in all respects to the diplococcus intracellularis meningitidis of Weichselbaum. It was isolated in pure culture from the spinal fluid of the 14 cases in which lumbar puncture was performed and is to be considered the causal agent in all the cases.

This organism was obtained from the circulating blood of two of the four investigated cases, but in one only did it grow on the various culture media.

The organism is probably only an occasional invader of the circulating blood. It may be present in the blood for many days during the course of the disease, and does not occur only as an agonal invader of the blood.

The diplococcus intracellularis meningitidis may occur in the pus of purulent conjunctivitis, a complication not infrequently seen in meningitis. It was isolated from one of the two cases which showed this complication in our series.

Secondary lung infections with pyogenic organisms are frequent, and a terminal bronchopneumonia was found in 5 of the 6 cases that came to autopsy, all of which showed the presence of pyogenic cocci.

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A CASE OF PRIMARY THROMBOSIS OF THE LATERAL SINUS, RUNNING ITS COURSE WITH OPERATION, AND AT NO TIME HAVING ANY INVOLVEMENT OF THE MIDDLE EAR.

By Frank M. Cunningham, M.D.,

LATE HOUSE SURGEON TO NEW YORK EYE AND EAR INFIRMARY; SURGEON TO EAR, NOSE, AND THROAT DEPARTMENT, CITY HOSPITAL, MACON, GA.

Mr. H., aged twenty-eight years, occupation stable manager, single. Family history negative. Physical examination: heart negative; lungs, small area of flatness (almost dulness) at base of right; exaggerated tubular sound at left apex.

January 7th. Patient complained of severe headache, pains in the back and legs, the pains in the legs being so severe that they were almost cramped, showing a decided spastic contraction. Temperature, 102°; pulse, 84; respiration, 16 to 18.

Diagnosis. La grippe. Treatment: Mercurial purgation in the form of calomel $\frac{1}{4}$ grain every fifteen minutes until eight doses were taken. Half-ounce Epsom salts following morning; also a combination of quinine sulphate, phenacetin, and caffeine citrate.

Result. Temperature somewhat controlled and pains relieved. For three or four days patient felt much better, although there was some slight elevation of temperature during the afternoon or evening.